View metadata, citation and similar papers at core.ac.uk
brought to you by CORE
provided by Xiamen University Institutional Repository

学校编码：10384　　分类号_____密级_____

学号：15420110153795　　UDC _____

厦门大学

博 士 学 位 论 文

人口死亡率水平的数量研究

——基于函数性数据的分析

Quantitative Study on Population Mortality Rate

——Based on Functional Data Analysis

王 洁 丹

指导教师姓名：　朱建平　教授

专 业 名 称：统　　计　　学

论文提交日期：2014　年　3 月

论文答辩时间：2014　年　5 月

学位授予日期：2014　年　6 月

答辩委员会主席：_____

评阅人：_____

2014 年 6 月

厦门大学博硕士论文摘要库

厦门大学博硕士论文摘要库

厦门大学学位论文原创性声明

本人呈交的学位论文是本人在导师指导下,独立完成的研究成果。本人在论文写作中参考其他个人或集体已经发表的研究成果,均在文中以适当方式明确标明,并符合法律规范和《厦门大学研究生学术活动规范(试行)》。

另外,该学位论文为(　　)课题(组)的研究成果,获得(　　)课题(组)经费或实验室的资助,在(　　)实验室完成。(请在以上括号内填写课题或课题组负责人或实验室名称,未有此项声明内容的,可以不作特别声明。)

声明人(签名):

年　　月　　日

厦门大学博硕士论文摘要库

厦门大学博硕士论文摘要库

厦门大学学位论文著作权使用声明

本人同意厦门大学根据《中华人民共和国学位条例暂行实施办法》等规定保留和使用此学位论文，并向主管部门或其指定机构送交学位论文（包括纸质版和电子版），允许学位论文进入厦门大学图书馆及其数据库被查阅、借阅。本人同意厦门大学将学位论文加入全国博士、硕士学位论文共建单位数据库进行检索，将学位论文的标题和摘要汇编出版，采用影印、缩印或者其它方式合理复制学位论文。

本学位论文属于：

（　　）1.经厦门大学保密委员会审查核定的保密学位论文，于　　年　　月　　日解密，解密后适用上述授权。

（　　）2.不保密，适用上述授权。

（请在以上相应括号内打“√”或填上相应内容。保密学位论文应是已经厦门大学保密委员会审定过的学位论文，未经厦门大学保密委员会审定的学位论文均为公开学位论文。此声明栏不填写的，默认为公开学位论文，均适用上述授权。）

声明人（签名）：

年　　月　　日

厦门大学博硕士论文摘要库

厦门大学博硕士论文摘要库

摘 要

死亡是重要的人口事件，对人口年龄结构的改变有重要作用，同时与经济、社会的发展有着密切联系。对死亡进行研究不仅有助于提高人口的健康水平和生活质量，同时能为政府制定各项经济、社会长期发展战略提供科学依据，为医疗服务、公共卫生及社会资源再分配等各项改善人类健康和生活状况的政策和措施提供参考。

我国自 1982 年开始现代化的人口普查，至今一共进行了四次。受限于人口死亡资料的匮乏，我国人口的死亡研究理论有待完善。使用函数性数据分析方法对人口死亡率进行研究，符合死亡率本应是一条光滑函数的特点，从函数的角度对死亡率进行分析，有以下优势：首先，拟合死亡率函数能完成对原始数据的光滑性修正；其次，函数性分析方法以死亡率函数为分析对象，将所有年龄别死亡率看成一个整体进行分析，不论是特征分析还是预测分析都从数据出发，较少依赖于模型的设定及各种假设。

本论文尝试从五个方面出发，利用函数性数据分析方法对我国人口的死亡率进行研究：

（一）综述死亡率分析方法及我国死亡研究现状。标准化粗死亡率度量了人群整体的死亡水平，年龄别死亡率刻画了死亡水平随年龄分布的特点，两者是进行死亡率研究的重要工具。我国人口死亡研究的数据主要来源于人口普查和抽样调查。最近四次普查数据是进行死亡研究的最佳数据来源，然而如何修正这些数据目前尚没有统一结论。数据不足和研究理论不完善是我国死亡研究面临的困难。

（二）应用函数性方法分析我国人口死亡率的特征。结果显示 1986 年以来人口的死亡水平总体上有逐渐减小的趋势。死亡率改善水平在 2000-2005 年间达到顶峰，之后有所回落。男性死亡水平持续高于女性，女性死亡率改善水平从 1995 年开始赶超男性。男女性各年龄别死亡率改善水平的差异在老年期最小，儿童期和育龄期差异最大。函数性方法发现 1986 年以来我国人口总体死亡模式呈现 J 形特征，具有四个阶段性变化。两性死亡率函数的首要特征为“高婴幼儿

厦门大学博硕士论文摘要库

死亡率、高老年人死亡率效应”，其次为“中老年死亡率波动效应”。在“中老年死亡率波动效应”上，男女性的波动方式有差别。

（三）使用函数性预测模型预测 2010 年之后十年我国人口死亡率函数。结果表明，预测未来十年女性的死亡水平仍然会低于男性，男女性新生儿预期寿命都将增加近 5 岁。男女性新生儿预期寿命自 1995 年以来持续增长，在 2000-2005 年达到最大，2005 年之后回落。预计 2010 年之后十年预期寿命仍将继续增长，但增长水平有减小趋势。

（四）研究死亡率函数地区差异与影响因素。死亡率函数存在地区差异，经济发展水平、教育水平以及城市化水平等对地区差异的影响最为显著。在社会经济发展因素与人口预期寿命的多元分析中发现，受教育程度与经济发展水平是影响男性预期寿命的主要因素，受教育程度与生育水平是影响女性预期寿命的主要因素，其中受教育程度是影响男女性预期寿命的最主要因素。

（五）结果的分析和讨论。原始数据的光滑性结果显示我国普查女性数据的质量要优于男性，0 至 9 岁数据质量相对较差。普查制度的完善和对数据的修正也许需更多关注男性数据及儿童数据。虽然预测死亡改善水平在 2010 年之后十年会有所下降，但伴随我国建国后第一次“婴儿潮”人口的逐步老年化，我国人口结构仍将迅速老龄化，应对人口老龄化、维护社会经济的可持续发展是政府现阶段需要面对的重大问题。加速发展社会经济水平，大力提高落后地区人口的受教育程度，提高城市化水平能较高效地降低人口死亡，提高人口健康水平，缩小地区差异。其中提高受教育水平对于降低男女性死亡水平的作用最大，经济发展水平和生育水平分别是影响男女性死亡水平的第二大因素。

关键词：人口死亡研究；死亡率；函数性数据分析

厦门大学博硕士论文摘要库

ABSTRACT

Death is an important demographic event. It plays an important role on changes in population age structure, and is closely linked with the development of economy and society. Researches in death theory not only help to improve the health and life quality of the population, but provide scientific basis for the government to develop long-term strategy of economic and social development. Moreover these researches will provide reference for policies and measures of the improvement of human health and living conditions, such as medical services, public health and redistribution of social resources.

China began the modern census since 1982. There are a total of four times. Limited by the lack of information of death, our population study on death theory needs to be improved. Using functional data analysis methods to study population death rate conforms to the characteristics of mortality, which should be a smooth function. From the perspective of the function of the mortality analysis, it has the following advantages: First, fitting mortality function completes smoothness correction of the raw data; Second, the analysis object of functional analysis method is mortality function, which regards all the age-specific mortality as a whole and less dependents on settings and assumptions of the model.

This paper attempts to use the functional data analysis method to study the mortality of our population from the following five aspects:

(a) Summarizing mortality analysis method and research status in China. Standardized Mortality Rate measures the death level of overall population. Age-specific mortality portrays the characteristics of the age distribution of mortality levels, which is an important tool in mortality study. Data information of the population death is mainly derived from the census and sample surveys. Four recent census data was the best source of data in study of death. However how to correct these data has no unified answer currently. Lack of data and holes in death research is problems in our country.

(b) Analyzing the characteristics of our population mortality using functional methods. The results show a gradually decreasing trend of the overall level of death since 1986. There is a peak of mortality improving level in 2000-2005, after a slight

厦门大学博硕士论文摘要库

drop. Male mortality level exceed female continually, while female mortality level to catch up with male since 1995. Difference between males and females in improvements of age-specific mortality is minimum in the old age, while maximum in childhood and childbearing age. Since 1986, China's population overall mortality patterns showed a J-shaped feature, with four stages change. The primary characteristic of gender mortality function is "high infant mortality, high elderly mortality effect", followed by "middle-aged mortality fluctuate effect". In the "middle-aged mortality rate fluctuation effect", there are differences in the way of volatility in men and women.

(c) Forecasting mortality function in a decade after 201 using function prediction model. The results showed that the level of female deaths over the next decade will still be lower than men, male and female life expectancy at birth will increase nearly 5 years old. Male and female life expectancy at birth continued to increase since 1995, reaching the maximum in 2000-2005, following a fall in 2005. Ten years after 2010 life expectancy will continue to increase, but growth levels have continued decreasing trend.

(d) Studying the area differences and impact factors of mortality function. There are regional differences in mortality function, which result from the differences in economic development level, education and urbanization levels, etc. Multivariate analysis of socio-economic development factor and population life expectancy reveals that education and economic development level are the major factors affecting men life expectancy , educational attainment and fertility levels are the main factors that affect women's life expectancy, and educational attainment is the most important factor affecting the life expectancy of men and women.

(e) Discussing the results and making policy recommendations. Smoothness results show the higher quality of the raw data in census data and in women than men, the relatively poor data quality in 0-9 years old. So improving and revising these census data to men and children's data need more attention. Death improving level will decline a decade later in 2010. As the first "baby boomer" population, after China founding, become agedness, rapidly aging structure changes of China's population will continue. Dealing with an aging population, maintaining social and economic sustainable development will be a major problem faced by the government at this stage. Accelerating the socio-economic development level, greatly improving the level of education in backward areas and the urbanization level can most efficiently reduce

厦门大学博硕士论文摘要库

death rate, improve population health and regional differences. Enhancing the role of education is the maximum factor in reducing death rate of men and women, economic development and fertility levels are the second major factor affecting the level of death for men and women.

Key Words: Population Death Research；Mortality Rate；Functional Data Analysis

厦门大学博硕士论文摘要库

厦门大学博硕士论文摘要库

目 录

第 1 章 绪论 1
1.1 研究背景与意义 1
1.2 研究综述 4
1.3 研究思路和方法 10
1.4 论文安排和创新点 12
第 2 章 人口死亡率分析方法及我国问题的研究 15
2.1 引言 15
2.2 死亡率数据的分析工具 15
2.3 死亡率数据的修正方法 20
2.4 人口死亡研究在我国的发展 25
2.5 本章小结 29
第 3 章 函数性数据的分析思想 31
3.1 引言 31
3.2 函数空间的分析工具 31
3.3 不同基函数的特征 43
3.4 数据的函数化预处理 51
3.5 本章小结 58
第 4 章 人口死亡率的特征分析 59
4.1 引言 59
4.2 函数性主成分分析概述 59
4.3 死亡率函数的拟合 70
4.4 基于函数性方法的死亡率特征分析 76
4.5 本章小结 83
第 5 章 人口死亡率的未来趋势分析 87
5.1 引言 87
5.2 函数性数据的预测分析 87

厦门大学博硕士论文摘要库

5.3 我国人口死亡率的未来趋势预测 92
5.4 残差分析及可信度验证 100
5.5 本章小结 103
第 6 章 死亡率水平地区差异与影响因素分析 105
6.1 引言 105
6.2 死亡率校正和函数化 105
6.3 总体死亡率水平特征和改善水平分析 109
6.4 人口死亡率函数的地区差异 113
6.5 人口死亡率函数地区差异的社会经济因素分析 119
6.6 本章小结 125
第 7 章 研究总结与讨论 129
7.1 研究总结与展望 129
7.2 讨论 132
参考文献 135
后 记 147

厦门大学博硕士论文摘要库

Contents

Chapter1 Introduction 1

1.1 Background and Motivation 1

1.2 Some Literature Reviews 4

1.3 Research Ideas and Process 10

1.4 Framework and Originalities 12

Chapter2 Analysis Methods of Population Mortality Rate and Research in China 15

2.1 Introduction 15

2.2 Analysis Tools of Mortality Data 15

2.3 Revise Methods of Mortality Data 20

2.4 Development of Population Mortality Research in China 25

2.5 Summary 29

Chapter3 Idea of Functional Data Analysis 31

3.1 Introduction 31

3.2 Analysis Tools of Functional Space 31

3.3 Features of Different Basis Functions 43

3.4 Functional Preprocessing of Data 51

3.5 Summary 58

Chapter4 Features Analysis of Population Mortality 59

4.1 Introduction 59

4.2 Overview of Functional Principal Component Analysis 59

4.3 Mortality Functions Fitting 70

4.4 Mortality Features Analysis based on functional methods 76

4.5 Summary 83

Chapter5 Future Trend Analysis of Population Mortality 87

5.1 Introduction 87

5.2 Forecasting Analysis of Functional Data 87

5.3 Forecasting Future Trend of Chinese Population Mortality 92

5.4 Residual Analysis and DependabilityVerification 100

厦门大学博硕士论文摘要库

5.5 Summary 103

Chapter6 Analysis of Mortality Regional Differences and Influencing Factors 105

6.1 Introduction 105

6.2 Mortalilty Revise and Funcional Preprocessing 105

6.3 Analysis of Total Mortality Level Features and Improvement 109

6.4 Regional Differences of Population Mortality Function 113

6.5 Social Economy Factors Analysis of Reginal Differences in Population Mortality Functions 119

6.6 Summary 125

Chapter7 Conclusions and Discussion 129

7.1 Conclusions and Future Development 129

7.2 Discussion 132

References 135

Acknowledgements 147

厦门大学博硕士论文摘要库

Degree papers are in the “Xiamen University Electronic Theses and Dissertations Database”. Full texts are available in the following ways:
1. If your library is a CALIS member libraries, please log on http://etd.calis.edu.cn/ and submit requests online, or consult the interlibrary loan department in your library.
2. For users of non-CALIS member libraries, please mail to etd@xmu.edu.cn for delivery details.

厦门大学博硕士论文摘要库